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SAVANT Status Report

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SAVANT Status Report

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Objective

This report will summarize the work related to this project that has gone on since February of 2008 and provide proposals for future collaboration with Japan. It will also outline the group's broad vision for safeguards modeling and simulation; this vision should guide the selection and implementation of next steps for the project.

Background

This project is a follow-on to the Safeguards Software Inventory Symposium, which brought together safeguards modeling and simulations experts from the US and Japan. The key objective of this meeting was to identify simulation and modeling tools necessary and available to develop and evaluate the safeguards system design.

[Taken from the Feb 2008 report]
We envision a general-purpose integrated safeguards tool which will initially build on existing software programs to combine them into a general-purpose safeguards software package, SAVANT, for the design, development and assessment of safeguards systems. The package will be modular in design so that users can select only the components of the tool relevant to their particular areas of interest. For example, SAVANT would allow a user to graphically design a facility layout, define MBA's, KMP's, and safeguards and physical protection systems. With a completed design, the user can examine the adequacy of a safeguards design at the facility and compare different configurations of the safeguards implementation to determine the effect on the overall system.

Modules that may be of immediate utility include:

- Graphical user interface to define a facility configuration
- Tool for defining MBAs and KMPs
- Tool for determining radiation source-terms at locations in a facility and to propagate those values throughout the material flow
- Tool for defining and assessing radiation measurement equipment
- Tool for defining and assessing video surveillance and assessing the impact on the facility safeguards
- Tool for defining and assessing general instrumented inputs (door switches, load cells, etc.)
- Tool for defining and assessing processing monitoring equipment for safeguards
- Tool for defining and assessing physical protection at a facility
- Tool to perform statistical analysis of measurement uncertainty to qualify quantitative estimations stemming from a completed facility model
- Risk Analysis to quantify "confidence building" measures

Summary of Work

In FY2009 a systems engineering approach to safeguards design and evaluation was developed as a guide for determining what a useful software package might look like. This approach was based on the Design and Evaluation Process Outline which has been successfully used for the design of physical security systems. The various codes identified early in this project were matched up to the different steps in the systems engineering approach. From this exercise, gaps were identified as well as areas of possible future linkage of codes.

Software tools for the analysis and evaluation step of safeguards systems were one area in particular found to be lacking. As a first step to examine integration of different codes, two separations-based codes were integrated. The Oak Ridge National Laboratory SEPHIS code is used to model transient solvent extraction for PUREX reprocessing. The Sandia National Laboratory SSPM code is used for safeguards system testing including diversion scenario analysis. By integrating the two codes, the final tool provides much more realism in the chemistry of the model which will allow more accurate safeguards analyses. It also will open up the door to examining process monitoring techniques.

Summary of Proposals

Future work will examine the integration of other codes into this combined reprocessing model such as burn-up codes and radiation source codes. The ability to assess technology for materials accountancy by determining radiation signatures at process steps could lead to instrumentation design and detector response studies. The development of an open-source code may be possible, but another option will be examined in parallel. The lessons learned from the integration can be used to create integration points within the SSPM model. This open model could be sent to Japan where specific proprietary codes for solvent extraction, burn-up codes, or source codes could be added. In this fashion, the capability would be provided without exchanging proprietary information. Below is a short list of possible work proposals:

1. Add in country-specific (proprietary) solvent extraction codes.
2. Benchmark the code with agreed-upon inputs.
3. Compare detector response for process monitoring or material accountancy measurements with various inputs and source terms.
4. Compare evaluation methodology

SAVANT Long-Term Vision and Short Term Objectives

In the short term, additional codes could be integrated into the combined model. However, the long-term vision is to produce a versatile safeguards design and analysis tool that will allow examination of a wide range of material accountancy systems, process monitoring systems, and diversion scenarios.

Conclusions

In this paper we describe a combined model for a safeguards design and analysis tool that could fulfill Safeguards by Design objectives. We are taking an initial design step and combining two separations-based codes. In a next step, we plan to simulate the addition of radiation detectors. We also offered suggestions on future work with Japan to benchmark the codes and to gain an international perspective.

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